TRANSMITTAL OF APPEAL BRIEF (Large Entity)	Docket No. YO998-532

In Re Application Of: Lu et al.

Application No.	Filing Date	Examiner	Customer No.	Group Art Unit	Confirmation No.
09/296,588	April 23, 1999	Qi. Lang	703-872-9318	2871	8615

Invention: METHODS OF REDUCING UNBALANCED DC VOLTAGE BETWEEN TWO ELECTRODES OF REFLECTIVE LIQUID DISPLAY BY THIN FILM PASSIVATION

COMMISSIONER FOR PATENTS:

Transmitted herewith in triplicate is the Appeal Brief in this application, with respect to the Notice of Appeal filed on 04/11/05

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Dated: 05/20/05

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In re patent application of

Lu et al.

Serial No.: 09/296,588 **Group Art Unit:** 2871

Filed: April 23, 1999 **Examiner:** Qi Zhi Qian.

For: METHODS OF REDUCING UNBALANCED DC VOLTAGE BETWEEN TWO ELECTRODES OF REFLECTIVE LIQUID DISPLAY BY THIN FILM PASSIVATION

Assistant Commissioner for Patents
Washington, D.C. 20231

APPELLANT'S APPEAL BRIEF

Sirs:

Appellants respectfully appeal the final rejection of claims 1-20 in the final Office Action dated January 11, 2005. A Notice of Appeal was timely filed on April 11, 2005.

I. REAL PARTY IN INTEREST

The real party in interest is International Business Machines Corp., Armonk, New York, assignee of 100% interest of the above-referenced patent application.

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Frederick W. Gibb, III

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II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to Appellants, Appellant's legal representative or Assignee which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-20 are all the claims pending in the application and are set forth fully in the attached appendix. Claims 1-20 were originally filed in the application. In response to an Office Action dated July 30, 2004 Appellants amended independent claims 1,3, 8,15, 17 in an Amendment under 37 CFR 1.111 filed on October 28, 2004. A final Office Action dated January 11, 2005 stated that claims 1-20 were rejected on prior art grounds. No amendments were made in the Amendment filed on March 3, 2005.

IV. STATEMENT OF AFTER-FINAL AMENDMENTS

No amendments were made in the Amendment filed on March 3, 2005. An Advisory Action dated March 22, 2005 indicated that the Amendment did not place the application in condition for allowance. The claims in the attached Appendix are as amended by the Amendment filed on October 28, 2004.

V. SUMMARY OF THE INVENTION

The invention uses a conducting amorphous film (carbon film or diamond-like carbon film) 35 to passivate both the electrode 38 and the pixel electrode 32 of a reflective-type

AMLCD shown in Figure 5A which makes the Vcom shift uniformly small across the display panel and stable over time under different operating conditions. Claims 1 and 15 define this layer as "a conducting amorphous layer" and claim 8 defines this layer as "a conducting diamond-like amorphous carbon layer."

With the inventive DLC layer 35, the Vcom shift is small and stable so that the display can be operated in the frame-inversion drive with a frame rate lower than 70 Hz without perceivable flicker. Further, the invention has lower power consumption because the display is driven with frame-inversion at low frequencies which allows lower voltage drivers to be used for the display. Because the voltage drop across the DLC film is much lower than that of PI film, low-cost CMOS processes for active substrates may be used. Also, with the invention, no extra mechanism is required to detect the Vcom shift in real time to provide feedback for the adjustment of Vcom voltage to minimize the flicker.

VI. ISSUES PRESENTED FOR REVIEW

The issues presented for review by the Board of Patents Appeals and Interferences are whether claims 1-3, 5, 7-10, 12, 14-17, and 19 are unpatentable under 35 U.S.C. §103(a) over Yasukawa (6,344,888) in view of Omori et al., hereinafter "Omori" (4,972,250) and Howe (4,640,744); whether claims 4, 11, and 18 are unpatentable under 35 U.S.C. §103(a) over Yasukawa, Omori and Howe, further in view of Hanihara et al., hereinafter "Hanihara" (5,990,988); and whether claims 6, 13, and 20 are unpatentable under 35 U.S.C. §103(a) over Yasukawa, Omori and Howe, in further view of Admitted Prior Art (APA). Appellants respectfully traverse these rejections based on the following discussion.

VII. ARGUMENT

A. The Rejection Based on Yasukawa, Omori, and Howe

1. The Position in the Office Action

The Office Action states:

> Claims 1-3, 7-10, 14-17, Yasukawa discloses (col. 6, line 48— col.7, line 52; col.52, lines 25-52; Figs. 1-7) that a reflection liquid crystal panel comprising:
>
> - a counter electrode (common electrode 33) composed of a transparent electrode (ITO), i.e., a first-type electrode or a transmissive electrode;
>
> - a reflective electrode (pixel electrode 14) using aluminum, i.e., a second-type electrode or a reflective electrode positioned opposite the transmissive electrode (the transmissive electrode is an opposite type of the reflective electrode);
>
> - a liquid crystal material (37) between the transmissive electrode (33) and the reflective electrode (14);
> - since the claims 7 and 14 described that the amorphous carbon layer comprising a passivation layer and since the specification (page 7, line 10; and page 6, lines 7-8;) described that the amorphous carbon layer is a passivation layer and the amorphous layer is a. . . Si02. . ..; such that Yasukawa discloses that a passivation film (17) is formed on the entire pixel electrode (14) and is composed of a silicon oxide (Si02) (Le., one of the first-type electrode and the second-type electrode having a passivation layer (amorphous carbon layer) which is adjacent the liquid crystal material.
>
> Yasukawa does not explicitly disclose that the amorphous carbon containing layer or diamond-like amorphous carbon

layer (passivation layer) provides a level of conductivity corresponding to a resisitivity between 10^4 and 10^{11} ohm-cm (the amorphous carbon containing layer or diamond-like amorphous carbon layer 'passivation layer' having a resisitivity between 10^4 and 10^{11} ohm-cm).

However, Omori discloses (col.4, lines 19-49) that the passivation material is amorphous carbon or diamond-like carbon (carbon having a diamond-like structure); and the semiconductive passivation material having diamond-like carbon characteristics dissipates charge build-up very quickly so that drift (the electrical drift) problems are minimized, Omori indicates (col.3, lines 6-13) that such passivation material is also applicable to other electrical assemblies such as thin film circuits (liquid crystal display also is a thin film circuits). Therefore, the semiconductive passivation material using amorphous carbon or diamond-like carbon in an electrical assembly would minimize the electrical drift problems.

Therefore, it would have been obvious to those skilled in the art at the time the invention was made to use amorphous carbon-containing layer or diamond-like amorphous carbon layer as a passivation layer for eliminating the electrical drift problems.

Still lacking limitation is such that the amorphous carbon layer or the diamond-like amorphous carbon layer having a resisitivity between 10^4 and 10^{11} ohm-cm.

However, Howe discloses (col.4, lines 46 — col.5, line 27) that the resisitivity of the amorphous carbon can be controlled over the range from about 0.1 to greater than about 1011 ohm-cm, and the amorphous carbon is utilized as a film which has been deposited on a substrate (deposited on conductors such as deposited on electrodes) which may be either an electrically conducting material or an insulating material, Howe discloses (col,1, lines 9-11; col.8, lines 35-36) that the amorphous carbon is used as an electrode material in electrochemical cell, and an electrochemical cell contain at

least two electrodes (liquid crystal display contain at least two electrodes), and the amorphous carbon layer is passivated on the electrodes, Howe indicates (col.3, lines 56— 60) that the amorphous carbon is utilized in the fabrication of highly effective electrodes,

According to MPEP 2144.05, in the case where the claimed range "overlap or lie inside ranges disclosed by the prior art (such as the range 10^4 and 10^{11} ohm-cm overlaps the range $0.1\text{-}10^{11}$ ohm-cm)" a prima facie case of obviousness exists.

Therefore, the ordinary skilled in the art would be able to combine those prior art to change the material of the passivation layer (using amorphous carbon or diamond-

like amorphous carbon); and passivated on electrodes (pixel electrode or common electrode) to eliminate the electrical drift problems so as to obtain a high effective electrode; and the resisitivity is a property of the material of the amorphous carbon,

Therefore, it would have been obvious to those skilled in the art at the time the invention was made to utilize amorphous carbon-containing layer or diamond-like amorphous carbon layer passivated on electrode having resisitivity of 10^4 and 10^{11} ohm-cm as claimed in claims 1-3, 7-10, 14-17 for eliminating the electrical drift problems and achieving highly effective electrodes.

Claims 5, 12 and 19, Yasukawa discloses (col.7, lines 37-38) that a polyimide alignment film is formed on the entire passivation film (17), i.e., a polyimide layer is formed between the passivation film (as the amorphous layer) and the liquid crystal material.

2. **Appellants' Position**

a. **Independent Claims 1 and 15**

i. **No Prima Facie Case of Obviousness**

Before addressing the individual prior art rejections, Appellant's note that the Office Action fails to set forth a prima facia case of obviousness. Therefore, all rejections are defective and should be withdrawn. Generally, the fact that the references teach away from the claimed invention, the lack of any objective motivation to combine references, and the large number of references demonstrates that a prima facia case of obviousness has not been set forth.

The claimed invention is directed to a reflective-type liquid crystal display. Yasukawa discloses a reflective-type liquid crystal display, however Yasukawa teaches directly away from the invention by requiring an insulator 17 be positioned as a passivating layer next to the electrodes, while the claimed invention utilizes an amorphous carbon-containing, slightly conductive layer adjacent the liquid crystal material. In order to modify Yasukawa to include this carbon-containing layer in place of the insulator, the rejection makes reference to Omori and Howe. Unfortunately, these references have nothing whatsoever to do with reflective-type liquid crystal displays. Omori is directed to passivating layers on semiconductor devices, such as bipolar and field effect transistors (col. 1, lines 13-26) and Howe is directed to electrochemical cells, such as energy generating photo electrochemical cells (col. 1, lines 7-11). It is unreasonable to suggest that the teachings from the these very different art fields could change the requirements in Yasukawa that an insulating layer be positioned next to the electrodes in a reflective-type liquid crystal display. Omori and Howe teach the use of carbon-containing layers and teach various ranges of resistivity and conductivity; however neither Omori nor Howe (nor any other prior art teaching) containing a suggestion that the teachings should be applied to reflective-type liquid crystal displays, much less that an amorphous carbon-containing layer

having the claimed a level of conductivity (the carbon containing layer that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm") should be substituted for the insulator disclosed in Yasukawa.

As described, for example, on page 21, lines 10-14 of the application, by using the amorphous carbon film to passivating the electrode 38 and the pixel electrode 32 of the reflective-type flickered crystal display, the Vcom shift is uniformly small across the display panel and stable over time under different operating conditions, which reduces the amount of flicker seen within the display. Because Yasukawa teaches that an insulator layer should be used in a position where the invention uses the amorphous carbon film, structures built according to the teachings of Yasukawa will suffer from a greater amount of flicker within the liquid crystal display.

The primary reference Yasukawa requires that an insulator (silicon oxide) be positioned as a passivating layer next to the electrodes. This teaches away from the claimed invention that defines a carbon-containing layer that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm." Clearly, by requiring that an insulator be positioned adjacent the liquid crystal material, Yasukawa teaches directly away from the claimed invention which utilizes a slightly conducting layer adjacent the liquid crystal material.

ii. Prior Art Does Not Teach or Suggest The Claimed Invention

Yasukawa does not teach or suggest the use of a carbon-containing film adjacent one or both of the electrodes in a reflective LCD device, as in the claimed invention. To the contrary, Yasukawa requires that an insulator (silicon oxide) 17 be positioned as a passivating layer next to the electrodes. Here, the claims clearly define an "amorphous carbon-containing layer" that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm." Silicon dioxide is an insulator, unless modified (as with carbon) so that it changes its insulating

characteristics. There is no teaching in the prior art of record of altering the silicon oxide insulator in Yasukawa to include carbon or in any other way to become a slightly conducting film. Yasukawa explicitly uses the silicon dioxide layer 17 as an insulator and calls the layer a "passivating layer." Yasukawa uses silicon oxide to prevent significant change in reflectance due to the variation of film thickness and wavelength of light.

Omori describes a passivating layer that is used to protect semiconductor devices against environmental influences (column 1, lines 14-26) and describes that the passivating material may be amorphous carbon, diamond-like carbon, etc. and that it may be used with semiconductor devices such as bipolar transistors and field effect transistors (column 4, lines 19-28). Omori only describes the amorphous carbon material as an insulator and does not describe that the amorphous carbon material could have conductive properties as in the claimed invention. There is nothing within Omori that would suggest to one ordinarily skilled in the art that the passivating layer described in Omori should be used with reflective-type liquid crystal display devices, much less that passivating layer should be used in the location that is defined by the claims in order to reduce or eliminate flicker within liquid crystal displays (or for any other reason). Therefore, it is Appellants' position that Omori would not have led one ordinarily skilled in the art to modify the requirements in Yasukawa that an insulating layer be positioned next to the electrodes in a reflective-type liquid crystal display.

Howe relates to electrochemical cells that utilize an electrolyte in contact with two or more cells, which can be utilized, for example, to generate energy from solar radiation (column 1, lines 66-column 2, line 9). Howe discloses that the resistivity of an amorphous carbon material can be controlled to be between 0.1 and 10^{11} ohms-cm. However, Howe does not contain any instruction or suggestion as to what the range of resistivity (conductivity) a passivating layer for a reflective type liquid crystal display should be. Howe does not even indicate that amorphous carbon materials should be utilized with liquid crystal displays. More importantly, there is no teaching within Howe that would suggest to one ordinarily skilled in the art that the requirements in Yasukawa of an insulating layer next to the electrodes should be

modified into a slightly conductive layer as in the claimed invention to produce any benefit, much less the benefit described above with respect to reducing flicker within the liquid crystal display.

In order to overcome the clear teachings of Yasukawa with respect to the use of an insulator layer next to the electrodes, to render the claimed invention obvious, it would be necessary for a teaching to explain that a different type of material should be used in place of the insulator within a liquid crystal display device. The prior art of record does not do this. Instead, the prior art of record merely describes general features of a passivating material (Omori) and of an amorphous carbon material (Howe). Omori and Howe described that their materials have many uses; however neither reference provides any suggestion of using any form of conductive material in place of the insulator described in Yasukawa, or even that their materials should be used with liquid crystal displays in any manner. Such a teaching is mandatory for any proper prima facia case of obviousness, when the rejection seeks to modify direct teachings of a reference (Yasukawa). Such a teaching is not present in the prior art of record, and this deficiency renders the rejection defective.

In view of the foregoing, Appellants submit that the Examiner has engaged in impermissible hindsight reasoning in order to arrive at a conclusion of obviousness. Further, the Examiner has selected a reference which teaches away from the claimed invention (Yasukawa) and references which are not analogous to the claimed invention (Omori, Howe) in arriving at a conclusion of obviousness. Only one of the three applied references relates to the claimed subject matter of reflective-type liquid crystal displays (Yasukawa) and this reference teaches away from the claimed invention by requiring an insulator layer where the claimed invention uses a slightly conductive layer. The remaining references (Omori, Howe) are drawn from non-analogous art fields and do not contain any teaching which would motivate one skilled in the art to modify the clear teaching within Yasukawa.

Therefore, the proposed combination of references does not teach or suggest the invention of independent claims 1and 15 that define the "amorphous carbon containing layer" that

"provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm" and such claims are patentable. In view of the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

b. Independent Claim 3

Appellant's again note that the Office Action fails to set forth a prima facia case of obviousness. Therefore, all rejections are defective and should be withdrawn. Generally, the fact that the references teach away from the claimed invention, the lack of any objective motivation to combine references, and the large number of references demonstrates that a prima facia case of obviousness has not been set forth.

Yasukawa does not teach or suggest the use of a carbon-containing conductive film adjacent one or both of the electrodes in a reflective LCD device, as in the claimed invention. To the contrary, Yasukawa requires that an insulator (silicon oxide) be positioned as a passivating layer next to the electrodes. Here, the claims clearly define a carbon-containing layer that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm...wherein the amorphous carbon-containing layer comprises one of a hydrogenated amorphous carbon silicon, germanium, SiO_2, Si_3N_4 and TiO_2".

Silicon dioxide is an insulator, unless modified (as with carbon) so that it changes its insulating characteristics. There is no teaching in the prior art of record of altering the silicon oxide insulator in Yasukawa to include carbon or in any other way to become a slightly conducting film. Yasukawa explicitly uses the silicon dioxide layer 17 as an insulator and calls the layer a "passivating layer." Yasukawa uses silicon oxide to prevent significant change in reflectance due to the variation of film thickness and wavelength of light.

Omori describes a passivating layer that is used to protect semiconductor devices against environmental influences (column 1, lines 14-26) and describes that the passivating material may be amorphous carbon, diamond-like carbon, etc. and that it may be used with semiconductor

devices such as bipolar transistors and field effect transistors (column 4, lines 19-28). Omori only describes the amorphous carbon material as an insulator and does not describe that the amorphous carbon material could have conductive properties as in the claimed invention. There is nothing within Omori that would suggest to one ordinarily skilled in the art that the passivating layer described in Omori should be used with reflective-type liquid crystal display devices, much less that passivating layer should be used in the location that is defined by the claims in order to reduce or eliminate flicker within liquid crystal displays (or for any other reason). Therefore, it is Appellants position that Omori would not have led one ordinarily skilled in the art to modify the requirements in Yasukawa that an insulating layer be positioned next to the electrodes in a reflective-type liquid crystal display.

Howe relates to electrochemical cells that utilize an electrolyte in contact with two or more cells, which can be utilized, for example, to generate energy from solar radiation (column 1, lines 66-column 2, line 9). Howe discloses that the resistivity of an amorphous carbon material can be controlled to be between 0.1 and 10^{11} ohms-cm. However, Howe does not contain any instruction or suggestion as to what the range of resistivity (conductivity) a passivating layer for a reflective type liquid crystal display should be. Howe does not even indicate that amorphous carbon materials should be utilized with liquid crystal displays. More importantly, there is no teaching within Howe that would suggest to one ordinarily skilled in the art that the requirements in Yasukawa of an insulating layer next to the electrodes should be modified into a slightly conductive layer as in the claimed invention to produce any benefit, much less the benefit described above with respect to reducing flicker within the liquid crystal display.

In order to overcome the clear teachings of Yasukawa with respect to the use of an insulator layer next to the electrodes, to render the claimed invention obvious, it would be necessary for a teaching to explain that a different type of material should be used in place of the insulator within a liquid crystal display device. The prior art of record does not do this. Instead, the prior art of record merely describes general features of a passivating material (Omori) and of

an amorphous carbon material (Howe). Omori and Howe described that their materials have many uses; however neither reference provides any suggestion of the using any form of conductive material in place of the insulator described in Yasukawa, or even that their materials should be used with liquid crystal displays in any manner. Such a teaching is mandatory for any proper prima facia case of obviousness, when the rejection seeks to modify direct teachings of a reference (Yasukawa). Such a teaching is not present in the prior art of record, and this deficiency renders the rejection defective.

In view of the foregoing, Appellants submit that the Examiner has engaged in impermissible hindsight reasoning in order to arrive at a conclusion of obviousness. Further, the Examiner has selected a reference which teaches away from the claimed invention (Yasukawa) and references which are not analogous to the claimed invention (Omori, Howe) in arriving at a conclusion of obviousness. Only one of the three applied references relates to the claimed subject matter of reflective-type liquid crystal displays (Yasukawa) and this reference teaches away from the claimed invention by requiring an insulator layer where the claimed invention uses a slightly conductive layer. The remaining references (Omori, Howe) are drawn from non-analogous art fields and do not contain any teaching which would motivate one skilled in the art to modify the clear teaching within Yasukawa.

Therefore, the proposed combination of references does not teach or suggest the invention of independent claim 3 that defines the carbon containing layer that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm…wherein the amorphous carbon-containing layer comprises one of a hydrogenated amorphous carbon silicon, germanium, SiO_2, Si_3N_4 and TiO_2" and such claims are patentable. In view of the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

c. Independent Claim 8

Appellant's again note that the Office Action fails to set forth a prima facia case of obviousness. Therefore, all rejections are defective and should be withdrawn. Generally, the fact that the references teach away from the claimed invention, the lack of any objective motivation to combine references, and the large number of references demonstrates that a prima facia case of obviousness has not been set forth.

Yasukawa does not teach or suggest the use of a diamond-like conductive film adjacent one or both of the electrodes in a reflective LCD device, as in the claimed invention. To the contrary, Yasukawa requires that an insulator (silicon oxide) be positioned as a passivating layer next to the electrodes. Here, the claims clearly define a "diamond-like amorphous carbon-containing layer" that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm." Silicon dioxide is an insulator, unless modified (as with carbon) so that it changes its insulating characteristics. There is no teaching in the prior art of record of altering the silicon oxide insulator in Yasukawa to include carbon or in any other way to become a slightly conducting film. Yasukawa explicitly uses the silicon dioxide layer 17 as an insulator and calls the layer a "passivating layer." Yasukawa uses silicon oxide to prevent significant change in reflectance due to the variation of film thickness and wavelength of light.

Omori describes a passivating layer that is used to protect semiconductor devices against environmental influences (column 1, lines 14-26) and describes that the passivating material may be amorphous carbon, diamond-like carbon, etc. and that it may be used with semiconductor devices such as bipolar transistors and field effect transistors (column 4, lines 19-28). Omori only describes the amorphous carbon material as an insulator and does not describe that the amorphous carbon material could have conductive properties as in the claimed invention. There is nothing within Omori that would suggest to one ordinarily skilled in the art that the passivating layer described in Omori should be used with reflective-type liquid crystal display devices, much less that passivating layer should be used in the location that is defined by the claims in order to

reduce or eliminate flicker within liquid crystal displays (or for any other reason). Therefore, it is Appellants position that Omori would not have led one ordinarily skilled in the art to modify the requirements in Yasukawa that an insulating layer be positioned next to the electrodes in a reflective-type liquid crystal display.

Howe relates to electrochemical cells that utilize an electrolyte in contact with two or more cells, which can be utilized, for example, to generate energy from solar radiation (column 1, lines 66-column 2, line 9). Howe discloses that the resistivity of an amorphous carbon material can be controlled to be between 0.1 and 10^{11} ohms-cm. However, Howe does not contain any instruction or suggestion as to what the range of resistivity (conductivity) a passivating layer for a reflective type liquid crystal display should be. Howe does not even indicate that amorphous carbon materials should be utilized with liquid crystal displays. More importantly, there is no teaching within Howe that would suggest to one ordinarily skilled in the art that the requirements in Yasukawa of an insulating layer next to the electrodes should be modified into a slightly conductive layer as in the claimed invention to produce any benefit, much less the benefit described above with respect to reducing flicker within the liquid crystal display.

In order to overcome the clear teachings of Yasukawa with respect to the use of an insulator layer next to the electrodes, to render the claimed invention obvious, it would be necessary for a teaching to explain that a different type of material should be used in place of the insulator within a liquid crystal display device. The prior art of record does not do this. Instead, the prior art of record merely describes general features of a passivating material (Omori) and of an amorphous carbon material (Howe). Omori and Howe described that their materials have many uses; however neither reference provides any suggestion of the using any form of conductive material in place of the insulator described in Yasukawa, or even that their materials should be used with liquid crystal displays in any manner. Such a teaching is mandatory for any proper prima facia case of obviousness, when the rejection seeks to modify direct teachings of a

reference (Yasukawa). Such a teaching is not present in the prior art of record, and this deficiency renders the rejection defective.

In view of the foregoing, Appellants submit that the Examiner has engaged in impermissible hindsight reasoning in order to arrive at a conclusion of obviousness. Further, the Examiner has selected a reference which teaches away from the claimed invention (Yasukawa) and references which are not analogous to the claimed invention (Omori, Howe) in arriving at a conclusion of obviousness. Only one of the three applied references relates to the claimed subject matter of reflective-type liquid crystal displays (Yasukawa) and this reference teaches away from the claimed invention by requiring an insulator layer where the claimed invention uses a slightly conductive layer. The remaining references (Omori, Howe) are drawn from non-analogous art fields and do not contain any teaching which would motivate one skilled in the art to modify the clear teaching within Yasukawa.

Therefore, the proposed combination of references does not teach or suggest the invention of independent claim 8 that defines the "diamond-like amorphous carbon containing layer" that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm" and such claims are patentable. In view of the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

d. Independent Claims 10 and 17

Appellant's again note that the Office Action fails to set forth a prima facia case of obviousness. Therefore, all rejections are defective and should be withdrawn. Generally, the fact that the references teach away from the claimed invention, the lack of any objective motivation to combine references, and the large number of references demonstrates that a prima facia case of obviousness has not been set forth.

Yasukawa does not teach or suggest the use of a carbon-containing or diamond-like conductive film adjacent one or both of the electrodes in a reflective LCD device, as in the

claimed invention. To the contrary, Yasukawa requires that an insulator (silicon oxide) be positioned as a passivating layer next to the electrodes. Here, the claims clearly define a carbon-containing layer that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm...wherein the amorphous carbon layer comprises one of a hydrogenated amorphous carbon silicon, germanium, SiO_2, Si_3N_4 and TiO_2". Silicon dioxide is an insulator, unless modified (as with carbon) so that it changes its insulating characteristics. There is no teaching in the prior art of record of altering the silicon oxide insulator in Yasukawa to include carbon or in any other way to become a slightly conducting film. Yasukawa explicitly uses the silicon dioxide layer 17 as an insulator and calls the layer a "passivating layer." Yasukawa uses silicon oxide to prevent significant change in reflectance due to the variation of film thickness and wavelength of light.

Omori describes a passivating layer that is used to protect semiconductor devices against environmental influences (column 1, lines 14-26) and describes that the passivating material may be amorphous carbon, diamond-like carbon, etc. and that it may be used with semiconductor devices such as bipolar transistors and field effect transistors (column 4, lines 19-28). Omori only describes the amorphous carbon material as an insulator and does not describe that the amorphous carbon material could have conductive properties as in the claimed invention. There is nothing within Omori that would suggest to one ordinarily skilled in the art that the passivating layer described in Omori should be used with reflective-type liquid crystal display devices, much less that passivating layer should be used in the location that is defined by the claims in order to reduce or eliminate flicker within liquid crystal displays (or for any other reason). Therefore, it is Appellants position that Omori would not have led one ordinarily skilled in the art to modify the requirements in Yasukawa that an insulating layer be positioned next to the electrodes in a reflective-type liquid crystal display.

Howe relates to electrochemical cells that utilize an electrolyte in contact with two or more cells, which can be utilized, for example, to generate energy from solar radiation (column 1, lines 66-column 2, line 9). Howe discloses that the resistivity of an amorphous carbon

material can be controlled to be between 0.1 and 10^{11} ohms-cm. However, Howe does not contain any instruction or suggestion as to what the range of resistivity (conductivity) a passivating layer for a reflective type liquid crystal display should be. Howe does not even indicate that amorphous carbon materials should be utilized with liquid crystal displays. More importantly, there is no teaching within Howe that would suggest to one ordinarily skilled in the art that the requirements in Yasukawa of an insulating layer next to the electrodes should be modified into a slightly conductive layer as in the claimed invention to produce any benefit, much less the benefit described above with respect to reducing flicker within the liquid crystal display.

In order to overcome the clear teachings of Yasukawa with respect to the use of an insulator layer next to the electrodes, to render the claimed invention obvious, it would be necessary for a teaching to explain that a different type of material should be used in place of the insulator within a liquid crystal display device. The prior art of record does not do this. Instead, the prior art of record merely describes general features of a passivating material (Omori) and of an amorphous carbon material (Howe). Omori and Howe described that their materials have many uses; however neither reference provides any suggestion of the using any form of conductive material in place of the insulator described in Yasukawa, or even that their materials should be used with liquid crystal displays in any manner. Such a teaching is mandatory for any proper prima facia case of obviousness, when the rejection seeks to modify direct teachings of a reference (Yasukawa). Such a teaching is not present in the prior art of record, and this deficiency renders the rejection defective.

In view of the foregoing, Appellants submit that the Examiner has engaged in impermissible hindsight reasoning in order to arrive at a conclusion of obviousness. Further, the Examiner has selected a reference which teaches away from the claimed invention (Yasukawa) and references which are not analogous to the claimed invention (Omori, Howe) in arriving at a conclusion of obviousness. Only one of the three applied references relates to the claimed subject matter of reflective-type liquid crystal displays (Yasukawa) and this reference teaches

away from the claimed invention by requiring an insulator layer where the claimed invention uses a slightly conductive layer. The remaining references (Omori, Howe) are drawn from non-analogous art fields and do not contain any teaching which would motivate one skilled in the art to modify the clear teaching within Yasukawa.

Therefore, the proposed combination of references does not teach or suggest the invention of independent claims 10 and 17 that define the carbon containing layer that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm...wherein the amorphous carbon layer comprises one of a hydrogenated amorphous carbon silicon, germanium, SiO_2, Si_3N_4 and TiO_2" and such claims are patentable. In view of the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

e. Dependent Claims 2, 5, 7, 9, 12, 14, 16, and 19

Appellants respectfully submit that dependent claims 2, 5, 7, 9, 12, 14, 16, and 19 are patentable because of the features they define, and because of their dependency from patentable independent claims. For example, claims 2 and 16 define a first-type electrode that comprises a transmissive-type electrode and a second-type electrode that comprises a reflective-type electrode. Claims 5, 12 and 19 define a polyimide layer, polyamide layer and oblique-evaporated inorganic layer between the amorphous carbon-containing layer and the liquid crystal material. Claims 7 and 14 define that the amorphous carbon-containing layer comprises a passivation layer. Claim 9 defines that the transmissive electrode comprises indium tin oxide and that the reflective-type electrode comprises aluminum. In view of the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

B. The Rejection Based on Yasukawa, Omori, Howe, and Hanihara

1. The Position in the Office action

The Office Action states:

Claims 4, 11 and 18, lacking limitation is such that the amorphous layer has a unidirectional orientation matched to the liquid crystal material, however, Hanihara discloses (col.5, line 41 — col.6, line 37; Fig.1) that an alignment film (8) made of silicon oxide (the specification page 7, lines 2-5 described that the amorphous carbon layer comprises Si02) is formed on the electrode (7), such that amorphous carbon-containing layer has a function to be an alignment film (having a unidirectional orientation matched to the liquid crystal material), and also functions as a protection film (passivation). Hanihara also indicated (col.5, lines 54-55) that the black matrix (9b) provided in the conventional display panel shown in Fig. 10 is obviated and such liquid crystal panel thereof is miniaturized and easy to manufacture (col.3, lines
54-57).

Therefore, it would have been obvious to those skilled in the art at the time the invention was made to use amorphous carbon containing layer serving as orientation as claimed in claims 4, 11 and 18 for achieving easy to manufacture.

2. Appellants' Position

a. Dependent Claims 4, 11, and 18

Hanihara does not cure the deficiency of the combination of Yasukawa, Omori, and Howe, shown above. More specifically, Hanihara does not teach or suggest the carbon

containing layer that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm" as defined by independent claims 1, 8, 15.. Indeed, Hanihara is only referenced for showing that silicon oxide has a unidirectional orientation matched to the liquid crystal material and is not intended to teach or suggest a diamond-like conductive amorphous layer. Therefore, any combination of Hanihara and Yasukawa, Omori, and Howe would not teach or suggest the carbon containing layer that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm" as defined by independent claims 1, 8, and 15.

Therefore, independent claims 1, 8, and 15 are patentable over any combination of Yasukawa, Omori, Howe, and Hanihara. Further, dependent claims 4, 11, and 18 are similarly patentable, not only by virtue of their dependency from a patentable independent claim, but also by virtue of the additional features of the invention they define. In view of the forgoing, the Board is respectfully requested to reconsider and withdraw this rejection.

C. The Rejection Based on Yasukawa, Omori, Howe and APA (Lu)

1. The Position in the Office action

The Office Action states:

> Claims 6, 13 and 20, lacking limitation is such that a voltage between the pixel electrode and the common electrode varies the transparency of the liquid crystal material.
>
> However, AAPA discloses (coft.3, lines 1-4) that varying the voltage to the electrode (106) (the pixel electrode) controls the liquid crystal cell (111), such that different amount of light are transmitted across the liquid crystal display (different transparency of liquid crystal material), thus resulting in the display of a gray scale of light. The voltage applied to the gate

> line of the TFT that is also varying the voltage applied to the pixel electrode, so that varies the voltage between the pixel electrode and the common electrode to control the transparency of the liquid crystal.
>
> Therefore, it would have been obvious to those skilled in the art at the time the invention was made to use a voltage between the transmissive electrode and the reflective electrode varies the transparency of the liquid crystal material as claimed in claims 6, 13 and 20 for achieving a display of gray scale as taught by AAPA.

2. Appellants' Position

a. Independent Claim 1

Neither the APA nor the previously discussed Yasukawa, Omori, or Howe teach or suggest the carbon containing layer that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm" as defined by independent claim 1. The APA (Figure 1, page 2, line 18-page 3, line 10 of the specification) teaches that when a voltage below a threshold voltage is applied to the gate line 107, the transistor 109 is in an off condition so that the potential on the data bus line 108 and electrode 106 are isolated from one another. When a voltage larger than the threshold voltage is applied on the gate bus line 107, the transistor 109 is in an on condition (low impedance state), thereby allowing the voltage on the data bus line 108 to charge the electrode 106. Varying the voltage to the electrode 106 controls the liquid crystal cell 111 such that different amounts of light are transmitted across the liquid crystal display, thus resulting in the display of a gray scale of light. A reflective type AMLCD is similar in structure to the transmissive type AMLCD; however, the transparent electrode 106 is usually replaced with a reflective metal electrode which generally occupies a larger area to cover the transistor 109.

As shown above, the claimed invention is fundamentally different than any of the teachings in the prior art. The invention avoids flicker LCD problems by using a slightly conducting thin film, e.g., diamond like carbon (DLC) film, coated on both the Al and ITO electrodes of reflective LCDs to reduce and stabilize the Vcom shift. The slightly conducting film allows electrical charges to flow toward the electrodes and bend the Fermi level of the adjacent electrode and balance the surface potential. Thus, with the invention, the Vcom shift is small and stable so that the display can be operated in the frame inversion drive with a frame rate lower than 70 Hz without perceivable flicker. Such features are simply not taught or suggested by the prior art of record. More specifically, none of the applied references teaches or suggests the carbon containing layer that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm" as defined by independent claims 1, 8, and 15.

Therefore, independent claims 1, 8, and 15 are patentable over any combination of Yasukawa, Omori, Howe, and the APA. Dependent claims 6, 13, and 20 define that the voltage between the first-type and reflective electrodes controls the transparency of the liquid crystal material. As shown above, Yasukawa is deficient in teaching that the carbon containing layer that "provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm" as defined by independent claim1. Contrary to such slightly conductive layers, the prior art actually teaches a passivating layer. Therefore, Appellant's submit that the prior art of record does not teach or suggest using such a conductive amorphous layer to control the transparency of the liquid crystal material as defined by dependent claims 6, 13, and 20. Therefore, dependent claims 6, 13, and 20 are patentable over the prior art of record. The concept of using a slightly conducting amorphous layer to control the transparency of the liquid crystal material is a concept that is independently patentable. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw this rejection.

IX. CONCLUSION

In view the forgoing, the Board is respectfully requested to reconsider and withdraw the foregoing rejections. Please charge any deficiencies and credit any overpayments to Attorney's deposit account number 50-0510.

Respectfully submitted,

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APPENDIX

1. (Previously Presented) A reflective-type liquid crystal display comprising:

a first-type electrode;

a second-type electrode positioned opposite said first-type electrode and being of an opposite type than said first-type electrode; and

a liquid crystal material between said first-type electrode and said second-type electrode,

wherein at least one of said first-type electrode and said second-type electrode includes an amorphous carbon-containing layer adjacent said liquid crystal material, wherein said amorphous carbon-containing layer provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm.

2. (Original) The reflective-type liquid crystal display in claim 1, wherein said first-type electrode comprises a transmissive-type electrode and said second-type electrode comprises a reflective-type electrode.

3. (Previously Presented) A reflective-type liquid crystal display comprising:

a first-type electrode;

a second-type electrode positioned opposite said first-type electrode and being of an opposite type than said first-type electrode; and

a liquid crystal material between said first-type electrode and said second-type electrode,

wherein at least one of said first-type electrode and said second-type electrode includes an amorphous carbon-containing layer adjacent said liquid crystal material, wherein said amorphous carbon-containing layer provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm, and

wherein said amorphous carbon-containing layer comprises one of a hydrogenated amorphous carbon silicon, germanium, SiO_2, Si_3N_4 and TiO_2.

4. (Previously Presented) The reflective-type liquid crystal display in claim 1, wherein said amorphous carbon-containing layer has a unidirectional orientation matched to said liquid crystal material.

5. (Previously Presented) The reflective-type liquid crystal display in claim 1, further comprising one of a polyimide layer, polyamide layer and oblique-evaporated inorganic layer between said amorphous carbon-containing layer and said liquid crystal material.

6. (Original) The reflective-type liquid crystal display in claim 1, wherein a voltage between said first-type electrode and said reflective electrode varies a transparency of said liquid crystal material.

7. (Previously Presented) The reflective-type liquid crystal display in claim 1, wherein said amorphous carbon-containing layer comprises a passivation layer.

8. (Previously Presented) A reflective-type liquid crystal display comprising:

a transmissive electrode;

a reflective electrode positioned opposite said transmissive electrode; and

a liquid crystal material between said transmissive electrode and said reflective electrode,

wherein at least one of said transmissive electrode and said reflective electrode includes a diamond-like amorphous carbon layer adjacent said liquid crystal material, wherein said diamond-like amorphous carbon layer provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm.

9. (Original) The reflective-type liquid crystal display in claim 8, wherein said transmissive electrode comprises indium tin oxide and said reflective-type electrode comprises aluminum.

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10. (Previously Presented) A reflective-type liquid crystal display comprising:
a transmissive electrode;
a reflective electrode positioned opposite said transmissive electrode; and
a liquid crystal material between said transmissive electrode and said reflective electrode,
wherein at least one of said transmissive electrode and said reflective electrode includes a diamond-like amorphous carbon layer adjacent said liquid crystal material, wherein said diamond-like amorphous carbon layer provides a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm, and
wherein said amorphous carbon layer comprises one of a hydrogenated amorphous carbon silicon, germanium, SiO_2, Si_3N_4 and TiO_2.

11. (Original) The reflective-type liquid crystal display in claim 8, wherein said amorphous carbon layer has a unidirectional orientation matched to said liquid crystal material.

12. (Original) The reflective-type liquid crystal display in claim 8, further comprising one of a polyimide layer, polyamide layer and oblique-evaporated inorganic layer between said amorphous carbon layer and said liquid crystal material.

13. (Original) The reflective-type liquid crystal display in claim 8, wherein a voltage between said transmissive electrode and said reflective electrode varies a transparency of said liquid crystal material.

14. (Original) The reflective-type liquid crystal display in claim 8, wherein said amorphous carbon layer comprises a passivation layer.

15. (Previously Presented) A method of forming a reflective-type liquid crystal display comprising:

forming a first-type electrode;

forming a second-type electrode positioned opposite said first-type electrode and being of an opposite type than said first-type electrode;

forming a liquid crystal material between said first-type electrode and said second-type electrode; and

forming an amorphous carbon-containing layer on at least one of said first-type electrode and said second-type electrode adjacent said liquid crystal material, wherein said amorphous carbon-containing layer is formed to provide a level of conductivity corresponding to a resistivity between 10^4 and 10^{11} ohms-cm.

16. (Original) The method in claim 15, wherein said forming of said first-type electrode comprises forming a transmissive-type electrode and said forming of said second-type electrode comprises forming a reflective-type electrode.

17. (Previously Presented) A method of forming a reflective-type liquid crystal display comprising:

forming a first-type electrode;

forming a second-type electrode positioned opposite said first-type electrode and being of an opposite type than said first-type electrode;

forming a liquid crystal material between said first-type electrode and said second-type electrode; and

forming an amorphous carbon-containing layer on at least one of said first-type electrode and said second-type electrode adjacent said liquid crystal material, wherein said amorphous carbon-containing layer is formed to provide a level of conductivity corresponding to a resistivity

between 10^4 and 10^{11} ohms-cm, and

wherein said forming of said amorphous carbon-containing layer comprises forming one of a hydrogenated amorphous carbon silicon, germanium, SiO_2, $Si_3N_4$and TiO_2 layer.

18. (Previously Presented) The method in claim 15, wherein method includes forming said amorphous carbon-containing layer to have a unidirectional orientation matched to said liquid crystal material.

19. (Previously Presented) The method in claim 15, further comprising forming one of a polyimide layer, polyamide layer and oblique-evaporated inorganic layer between said amorphous carbon-containing layer and said liquid crystal material.

20. (Original) The method in claim 15, wherein a voltage between said first-type electrode and said reflective electrode varies a transparency of said liquid crystal material.